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Military Operational Requirements for Computer Assisted eXercises (CAX) in NATO

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Summary

Training followed by exercises enables individuals and teams to acquire and perfect knowledge and skills. In addition exercises provide an opportunity to acquire knowledge on strategies for the employment of newly acquired skills. However the ability to measure knowledge and skill acquisition decreases with the complexity of exercises. From a NATO perspective various types of exercises involve one or two echelons of command and focus primarily on the employment of joint and combined forces in a wide spectrum of operations. To exercise effectively a combination of simulation, data, mediation software and personnel is required. It is necessary to invest in the development of a CAX support team to ensure that suitable simulations are selected and that they are employed effectively. Configuring the data required by simulations and the measures of performance that can be collected for exercise control and analysis purposes, can also be supported by this team. Training of augmentation personnel needs to be incorporated in the exercise preparation process. Finally the necessary support needs to be provided to ensure that headquarters can employ their regular command and control systems. C2 capabilities must be initialised with data that is consistent with the exercise setting, they receive must regular stimuli in the form of messages of sensor input and their formal tasking should transmitted as efficiently as possible to the exercising environment.

1 Introduction

Requirements for computer assisted exercises can be derived from the various types of exercises that are conducted in NATO and from the operating environment that can be sustained in NATO to prepare, conduct and analyse such exercises.

Within NATO, the concept of training and exercises includes three different phases of knowledge acquisition that applies to groups and single individuals, namely instruction, training and exercising. Without specifying detailed definitions of these terms, we can state that instruction refers to the acquisition of skills by an individual or group for the first time. Instruction is followed by training, which is aimed at improving the performance of individuals and teams at employing their newly acquired skills and knowledge. Exercises can be conducted after effective training has taken place. In general terms, there are three specific goals that can be achieved through exercising. Firstly, exercises can be used to maintain skills acquired during training at a specified level of performance. Secondly, exercises can enable teams and individuals to generalise their knowledge by being exposed to a wide variety of situations. Finally exercises can be used to develop the knowledge about the conditions in which to best use specific skills i.e. which strategies to apply in which situations. This last aspect is also referred to as the development of meta-knowledge.

In the progression from instruction to exercises, the environment that is used to achieve the transfer of knowledge becomes more complex and the understanding about the use of the transferred knowledge increases in the team or individual. Hence exercising environments are the most complex and therefore require formal representations, which are typically well suited to automation. A major contributing factor to the level of complexity is the degree to which the quality of knowledge transfer can be assessed by measuring the performance of the individuals or teams involved in instruction, training and exercising. While performance

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measurement can be specified and executed well in instruction, it becomes increasingly difficult in training and appears to be ill-specified in exercising. However the quality of knowledge transfer is directly related to the capability to measure performance and must therefore be addressed and supported. Extensive instrumentation of the exercising and working environment is required.

In the new security environment that has emerged over the past ten years, the structure and composition of the armed forces in many NATO nations has changed considerably. In particular, many nations have transitioned from an army based on conscription to fully professional armed services. This new form of organisation relies on many persons joining the ranks of the armed forces for short-term contracts. However the sustained economic growth in most nations has made it difficult to attract suitable people. This effect is compounded by the considerable amount of highly skilled and experienced professionals that have left the armed forces. Therefore the need for a sustained training and challenging exercising environment that provides a consistent level of knowledge transfer, has become even more pressing.

When considering the general context of exercises, we also need to note that many operations are conducted on an “ad hoc” voluntary participation basis by nations. These many often small-scale commitments place a considerable and sustained demand on limited personnel resources. Since planning for these operations cannot be foreseen and incorporated in planned training and exercise events, the training environment must be highly configurable and composable to include relevant elements in order to prepare personnel participating in these operations effectively. Furthermore, good performance measurement is required to establish the ability of the personnel to carry out their tasks in an often highly visible environment from a political and media perspective. These inherently multi-national operations almost invariably involve non-NATO personnel who are unfamiliar with NATO tasks and procedures and need to be trained and exercised to work together in an effective manner.

Co-operation with non-governmental and private volunteer organisations has also increased considerably. Since military forces are often responsible for the overall security in the area and for the protection of local populations as well as external organisations, the representatives from these organisations also need to be trained.

Furthermore, it should be noted that a new problem is emerging as a result of the many parallel operations that are being conducted by forces from NATO nations. Due to the length of these commitments, it is becoming increasingly difficult to ensure that military personnel is trained on the full spectrum of tasks that they are expected to be able to deal with. Therefore, training and exercising is required whilst personnel is deployed and will need to be inherently distributed.

Overall there is a greater need for training and exercising environments that can be configured rapidly and made widely available to a broader community of people requiring their skills to be developed in a planned and consistent manner. Also there needs to be greater emphasis on a verifiable level of skill in personnel because the room for error has become extremely small due to the high degree of media coverage and to the stringent and detailed political guidance.

2 Classes of Computer Assisted exercises in NATO

Recently NATO has revised its training and exercise strategy and has identified two main classes of exercises as requiring extensive computer assistance in their exercises. These so-called level 2 and level 3 exercises are regularly scheduled exercises that involve two echelons of command. The actual focus is always on the lowest echelon that participates. Indeed the time required by the lowest echelon to perform its command and control cycle cannot be compressed and constitutes a delay for the highest echelon to receive feedback. Level 2 exercises involve the regional, joint sub-regional and component command headquarters. Level 3 exercises include joint sub-regional and component command headquarters as well as national or multinational formation headquarters. For both types of exercise, the force composition depends greatly on the ability of headquarters to participate as response cells. Indeed, exercises can only be successful when the information flow that surrounds the headquarters can be simulated to an extent that is sufficient to make part or whole of the headquarters perform its functions. Response cells, which represent the subordinate force headquarters, are critical to the implementation of the external information flows of a headquarters.

In preparation for many level 2 and 3 exercises, headquarters conduct individual and collective training events. If possible, headquarters would like to apply the same computer assisted environment and scenario that is utilised in the multi-headquarters exercise that they are working towards. The type of application that is required is twofold, namely the generation of a set of information stimuli and the conduct of small-scale simulations. In the first case, headquarters exercise planners should be able to generate an information flow from the simulation environment that can be used to stimulate selected headquarters functional areas. By executing limited simulation runs in which exercise planners perform all the functions of the exercise components and generate a consistent flow of information over time. The collected set of messages and situation snapshots can subsequently be replayed and injected into the headquarters for selected sections. The objective is to train sections into the procedural execution of their functions. It is essential to conduct such exercises in view of the regular rotation of personnel. Having concluded the procedural training satisfactorily, small-scale headquarters exercises can be organised during which headquarters personnel perform some of the exercise control cell functions. The dynamic nature of the training enables the staff sections to perform complete command and control cycles and to interact with other sections, thus enabling internal headquarters processes to be tuned effectively. Obviously these additional exercise generation requirements can only be facilitated if headquarters have access to a simulation capability that can be executed within their infrastructure and that can be managed within the available limited personnel resources. From a data set preparation point of view, they can benefit from the work that is conducted for the larger exercises or they can re-use paste exercises.

In addition to the regularly scheduled exercises, the NATO modelling and simulation master plan has identified the Combined Joint Task Force (CJTF) headquarters exercises as being able to benefit greatly from the application of simulation technology. In particular the ability to tailor the simulation environment through the application of emerging simulation interoperability frameworks is perceived as having great potential in building an effective training and exercising environment for the many different types of operations that a CJTF headquarters may be called upon to conduct in co-operation with many different force providers. Overall the requirements of CJTF exercises are comparable to those of regular NATO level 3 exercises although the emphasis may be placed more on the peace support operations aspects of the mission and participating forces will almost definitely include forces provided by non-NATO nations. Hence this type of exercise introduces the need to be able to address the representation of these forces in operations where civil and military co-operation issues are highly important.

Finally, NATO is in the process of establishing a training organisation that intends to make extensive use of simulation to perform its various training roles. The concept of the ACE Command and Staff Training Programme (ACSTP) centres on the ability to provide individual and collective training to headquarters according to a verifiable set of performance standards. The ACSTP requires a set of tools to design and implement training and exercise scenario’s that will create the conditions for headquarters to execute their command and control processes so that they may achieve prescribed performance standards on an individual and collective basis. The ability to collect sufficient data to compare individual and collective actions and results to normative measures will be essential in ensuring that the ACSTP meets its objectives.

As an overall constraint for the design of exercise and training environments, it should be noted that efficiency considerations mandate that scenarios should be re-used on an extensive basis. Hence the attraction of generic versus specific scenarios and particularly the use of generic forces and structures. However experience has shown that training benefits are considerably greater when applying realistic and representative forces and environments primarily due to the additional meta-knowledge that is acquired by the subjects of training and exercises.

As discussed above, the implementation of a headquarters external information flow requires the availability of teams of personnel, which represent organisations that the headquarters would interact with. In addition to the headquarters subordinates, these cells typically include:

(1) A higher headquarters cell representing the headquarters that command the exercising headquarters

(2) A host nation support cell representing the various nations that are part of the scenario and that provide logistic and legal interaction to the headquarters

(3) A non-governmental and international organisations cell

(4) A media cell

(5) Other forces cells, which represent the other parties, that play an active role in the scenario. Other forces may entertain amicable or belligerent relationships with the headquarters or may be considered as neutral.

These cells need to be able to interact with the headquarters in the manner that would be realistic for them. This implies the usage of doctrinal communications and information systems assets, commercial communications means as well as all forms of open media expression.

3 Joint Operational Level Mission Requirements

Within the context of a joint operation, the mission of the joint headquarters is to co-ordinate the actions of various component commanders. In general terms, this will entail that a land mass is secured that is part of the theatre of operations and that constitutes the focus of ground operations, that an associated air space is suitably controlled and that similar conditions are created in a specified maritime area. In particular, the complementary use of force capabilities is the focus of the joint aspect of planning and execution. The types of missions that a joint headquarters will expect its Land Component Commander (LCC) to perform can be summarised as including:

(1) Disaster relief and humanitarian aid: this would entail the provision of a secure environment on land for the conduct of:

(a) food distribution,

(b) medical care,

(c) engineering support,

(d) return of displaced persons,

(e) civilian activities ensuring the return to an organised and law abiding society e.g. elections

(2) Peace keeping: within the context of an approved operation in a sovereign state, the LCC would contribute to the stability of the situation by projecting sufficient military presence to discourage unwanted organised violent actions by factions within the nation or by other nations. This type of mission would most probably be combined with a number of aspects described under the aspect related to humanitarian relief due to the likely degradation of local security, provision of community resources and breakdown of infrastructure.

(3) Peace enforcement: establishment through military means of a secure environment to implement the political rationale that led to the conduct of the operation. Such an operation would typically involve various unfriendly factions and a state that does not agree to the military intervention. Although assumed of limited scale, this kind of operation may cover the entire spectrum of military actions.

(4) Protection of the integrity of the NATO nations territory: still the primary mission of the headquarters of the alliance, these types of operations would probably involve the massive use of alliance military power to restore the territorial integrity of the alliance. Although the likelihood of such an operation appears relatively low at this time, headquarters need to be capable of managing the complexity that would be involved with the massive use of military force.

For air matters, the Joint Force Air Component Commander is responsible for the provision of air support in terms of protection of air space from any violent opposition, air reconnaissance, transportation of personnel, equipment or food and support by ground offensive-capable aircraft. Due to the high degree of technological sophistication of the aircraft, weapons and sensors employed by the air force, a relatively higher degree of fidelity needs to be achieved in the representation of these assets compared to land forces.

For maritime matters, a maritime component command would be expected to be able to perform tasks like ensuring the security of ports that are used by maritime forces or commercial shipping bringing resources to the area, guaranteeing the control of specified maritime areas or carrying out the implementation of sea embargoes, etc. Any amphibious operations that could be complementary to the activities of the Land Component Command would also be expected to be managed by the maritime component or by a specific marine command in close co-ordination with land and air components. From a joint perspective, the representation of amphibious operations requires the environmental conditions to be suitably selected to portray issues of access and time required to perform a successful landing.

For logistic matters, co-ordination needs to take place to establish the arrival of forces, the requirements and provision of supplies, the capability to protect and maintain the equipment used by the force and the organisation of medical assistance.

For special operations matters, a specific component command would be tasked to address specific requirements for intelligence collection or specific detailed interactions with local entities. A high degree of fidelity needs to be represented to provide a reliable depiction of the teams and assets that are employed and tasked to conduct special operations.

4 Environmental Representation Requirements

The following environmental elements should be represented by a simulation capability in order to portray their impact on the entities involved in a simulation of a joint combined operation

(1) Terrain conditions that influence cross-country movement, maritime movement and potentially airborne operations, detection, transitions from sea to land and vice versa. Of particular importance are major obstacle features e.g. rivers, gorges, fjords

(2) Light conditions: day, night, transitions between night and day, fog, cloud cover

(3) Weather: wind, precipitation, temperature, barometric pressure, cloud levels

(4) Artificial environment elements: smoke

(5) Disease: type of effect on personnel and supplies (lethal or non-lethal, reduction of effectiveness over time), method and rate of transmission, average duration of disease

(6) Infrastructure:

  (a) Road networks

  (b) Railway networks

  (c) Power networks

  (d) Communications networks

(7) Urban areas

The impact of the environment could include the following aspects:

(1) influence on line of sight by terrain features, light conditions either natural or artificial

(2) mobility

(3) counter-mobility

(4) sensor effectiveness

(5) weapon effectiveness

(6) personnel effectiveness

(7) quality and usage of supplies

5 Force representation requirements

From a land component perspective, it may be necessary depending on the size of the allocated force to model individual battalions and companies. Due to the potential allocation of specialised units and their allocation from a contributing nation, units down to platoon level may require representation.

Units should be described as consisting of various types of personnel, a description of vehicles, combat systems, supplies and holdings, sensors, communications and information processing assets and other elements which contribute to the functioning of the unit e.g. mobile bridges, building equipment. In addition factors of morale and welfare of the units may be described. Unit leadership style, co-ordination and overall cohesion may also be included as descriptive characteristics.

From an air component perspective, the following air assets and activities need to be represented in a simulation environment that is used to support joint exercises:

(1) Airbases: should include local sensors, runway capability, parking capability, shelter capacity by type, local air defence assets, local ground defence assets

(2) Squadrons

(3) Pilots, crews or occupants of aircraft when they are in exceptional conditions e.g. after a crash or in a hostage situation

(4) Ground-based air defence assets

(5) Ground-based air search radars

(6) Air missions:

  (a) Offensive: against specific targets or target classes, orbiting or not

  (b) Defensive: orbiting or on base alert

  (c) Support missions: escort, suppression of air defence, air to air refuelling, reconnaissance (orbiting and others), electronic warfare, early warning, command and control

  (d) Transport missions

(e) Maritime patrol: either anti-surface or anti-submarine

(f) Packages: support mission providing protection and assistance to multiple principle missions.

From a maritime perspective, the following assets and activities need to be represented:

(1) Surface and sub-surface craft including carrying capacity, supplies, on-board squadrons, sensors, jammers, air defence assets, anti-submarine assets,

(2) Landing craft

(3) Amphibious craft

(4) River operations capable craft

(5) Marine units including ground capable forces, squadrons and support units

(6) Ships should be able to provide missile firing support on targets, to perform gunfire support, to facilitate the processing of land forces through ports, to conduct amphibious landings, to detect and affect air assets, to launch air missions and packages

From a logistics perspective, the following assets and activities need to be represented:

(1) Supply units either fixed or mobile, supporting other units with specific supplies using convoys of cargo trucks, tanker trucks, railway assets; barges or aircraft

(2) Maintenance units capable of transporting and repairing damaged equipment

(3) Medical transportation assets, field hospitals and fixed location hospitals and treatment facilities

(4) Medical personnel and teams available to perform specific activities

Special forces:

(1) Specialised units, which have the ability to remain highly undetectable, can perform special observation actions and damage-selected targets.

(2) Units can be inserted or extracted by aircraft, boats or other transportation assets.

The entities and objects described above should be capable of performing a relevant subset of the following functions:

(1) Movement functions

(2) Combat functions

(3) Fire support

(4) Air defence

(5) Search and rescue

(6) Engineering functions

(7) Communications functions

(8) Medical functions

(9) Intelligence collection and fusion functions

(10) Movement control functions

(11) Sustainment and maintenance function

6 Non-military entity representation requirements

The context of any military operation will require direct interaction with civilian entities and will result in exchanges of supporting elements. Therefore the civilian assets that can contribute to the operation or that are the subject of the operation need to be represented as active objects in the simulated environment. These objects include:

(1) Civilian transportation assets (land, air and maritime shipping)

(2) Movement control authorities

(3) Industrial production capabilities and their controlling authorities

(4) Power and fuel production and distribution authorities/entities

(5) Medical support and transportation capabilities

(6) Food and water production and distribution capabilities

7 Exercise Operational requirements

In order to provide operational utility for exercise purposes, the simulation environment that supports an exercise must meet the representation and functional requirements discussed in the previous sections. In addition, it must also allow the exercise planning staff to configure the environment within acceptable time lines and affordable resource requirements. It should allow the conduct of exercises with limited augmentation and support data collection to perform analysis and after-action-review.

7.1 Simulation selection

In view of the evolving requirements of headquarters concerning the aspects of the real world that they wish to exercise, exercise planners could greatly benefit from the ability to select and configure simulation environments to best meet the complete set of specific exercise requirements. A repository of simulations that are realistic candidates for exercise support would be required to facilitate the selection process. Simulations can be considered realistic candidates to support an exercise if they have been proven in previous exercises. More importantly though is the availability of organisations that can ensure their proper employment, the constitution of effective simulation data bases, the training of augmentation personnel and the necessary interaction between simulation and command and control systems. Indeed it should not be considered as a recommended approach to attempt to constitute this kind of capability within the planning cycle of an exercise. In this context, simulations can be either interpreted as single tightly organised simulation models or as combinations of simulations that are capable of inter-operating.

Should existing simulation environments not include all the desired functionality, exercise planners need access to a process that allows them to introduce requirements for new developments that are either part or can inter-operate with components that have been used successfully for previous exercises. In order to formalise this process, a repository of simulation modification requests needs to be available to register requests officially. An organisational entity within NATO needs to be appointed as the custodian of this repository. In close co-ordination with the NATO strategic commands, funding for modifications can be requested for the implementation of prioritised sets of modifications. This approach ensures a consistent development of

simulation capabilities that are beneficial to a wide variety of exercise applications. The CAX management organisation should subsequently manage the implementation and test of the modifications. Furthermore it should perform the following roles:

(1) serve as the proponent for NATO of realistic simulation candidates for exercises

(2) develop and expand the NATO reference repository of simulation descriptions

(3) act as the advisor to headquarters in the simulation selection process

(4) in the case of federations of interoperable simulations, act as the accreditation authority for utilisation in NATO exercises.

Indeed, it must be recognised that it is necessary to invest in a team of experts to apply complex simulation environments effectively for training and exercises.

A final point that needs to be addressed is the need for the ratio between simulation time and real time to be able to vary between 0.01 and 60. Although exercise conduct will not require ratios of above 3 or 4 to 1, data base validation and test sessions will require much higher ratios to be completed in a cost-effective manner.

7.2 Data base preparation time and effort

Having selected a number of simulation environments that are realistic options to support training and exercise events, it is necessary to establish an environment to create and maintain descriptions of the entities described in sections 4, 5 and 6. The descriptions must be such that they can be transformed into suitable data for various simulation environments. In addition they must comply with any constraints and requirements that are imposed by the command and control system applications that are employed by the headquarters participating in associated exercises. Indeed the effectiveness of an exercise is directly dependent on the ability to employ the tools that staff would be required to employ to perform their mission. Since NATO as an organisation does not own forces and operates very few systems within its structure, most data needs to be provided through national channels. Hence CAX data management is an inherently distributed activity in a NATO context.

As discussed in the section 7.1, the simulation management organisation that needs to be constituted should also be given the responsibility to manage the data that is used to populate simulation environments that are used for exercises. The organisation should develop a process that ensures the verification and validation of data by the nations whose forces and capabilities are to be simulated. The necessary environmental data should also be gathered from national sources. Tools that support the distributed data collection effort as well as a robust and secure communications architecture are necessary to develop and maintain relevant data sets. In particular distributed access to simulation environments is necessary to enable data providers to validate the behaviour of representations in combination with specific simulation environments. Indeed it is not sufficient to verify the characteristics of entities in a static manner. The dynamic characteristics need to be verified also and compared to expected behaviours when interacting with the environment and with other entities. This form of testing can only be accomplished by accessing the simulation environments.

Once an exercise data set has been compiled, verified and validated, it should be suitably documented to enable augmentation personnel to be trained and to provide exercising headquarters with reference data. Several forms of documentation should be supported and formats should be flexibly configurable.

Finally data management tools should be available that enable the flexible re-use of data that has been developed for previous exercises either in part or in full. Considerable efficiency gains can be obtained in this manner.

Overall the process of designing, compiling, verifying and validating exercise data sets should be completed within a 6 to 9 month time frame.

7.3 Exercise control cell requirements

As discussed in section 2, a number of exercise control cells need to be formed to conduct an exercise. They include:

(1) Response cells representing the headquarters and forces that are subordinated to the exercising headquarters

(2) A higher headquarters cell representing the headquarters that command the exercising headquarters

(3) A host nation support cell representing the various nations that are part of the scenario and that provide logistic and legal interaction to the headquarters

(4) A non-governmental and international organisations cell

(5) A media cell

(6) Other forces cells, which represent the other parties, that play an active role in the scenario. Other forces may entertain amicable or belligerent relationships with the headquarters or may be considered as neutral.

These cells need to be able to interact with the headquarters in the manner that would be realistic for them. This implies the usage of doctrinal communications and information systems assets, commercial communications means as well as all forms of open media expression.

Obviously the size and composition of these cells should be as limited as possible to perform their function. As a general rule, the size of cell should not exceed 25 people and preferably be composed of less than 10 people. The profile of the personnel should be functional area experts. This requires the interfaces of the simulation and information exchange environments to be suitably designed to express their activities and information in a manner that is tailored to their specific professional backgrounds. Performing clerical activities such as re-formatting data either in textual or graphical form should be avoided.

In addition, the amount of training required to operate the simulation environment and to interact with the exercising headquarters should not exceed three to four days including the conduct of a mini-exercise. In order to achieve the most effective knowledge transfer, prospective augmentation personnel should be able to train on operating the simulation environment and the information exchange tools at their regular place of work. The final training phase could subsequently focus on acquiring a good understanding of entities that the cells will be managing, on the intended exercise flow and on the information flow that needs to be established with the exercising headquarters.

7.4 Exercise management support

A cell that was not discussed in the previous sub-section is the exercise management cell. The persons that make up this cell need to combine a profound understanding of the exercise objectives, of the courses of action that have been designed by the exercising headquarters, of the simulation environment that is being employed and of the simulation data sets that have been compiled to support the achievement of the objectives. Their principal mission is to monitor exercise progress and to identify and advise on any immediate or other important events that may cause the exercise to deviate from its intended path to such an extent that the intended objectives cannot be met.

In order to perform their mission, the intended flow of the exercise needs to be expressed in a manner that can be monitored during the execution of the exercise. Monitoring entails the ability to collect data from the simulation environment and combine it into aggregate measures. Depending on the objectives of the exercise, these measures may vary and in some cases they may be directly at the level of detail of the simulation

environment. Hence the exercise management cell should be able to compose the measures and express how they should be monitored over time.

Examples of measures of performance that may require monitoring are:

(1) Force ratios for ground forces in specified geographical areas. Such ratios are combined with empirical knowledge to assess very rapidly what the trend of the exercise is and whether it is in line with the expected exercise flow. Should the actual trend deviate too much over time from the intended evolution, exercise directing staff may wish to capture the reasons for the deviation for after-action review purposes and may wish to introduce elements that may reduce the deviation without appearing to be artificial to the exercising headquarters.

(2) Attrition of high value assets for air and maritime forces. Given the many scarce resources that are employed in these forces and their potential to influence operations in a significant manner, any attrition needs to be reported and its causes identified. The directing staff must be able to make a timely assessment of the impact of the attrition on the course of the exercise and develop suitable courses of action from an exercise management perspective.

From the examples above, it may become clear that exercise management staff require the ability to monitor events and trends in a flexible manner. Just as important, is the ability to understand the reasons for them. Therefore detailed information about entity characteristics, exact situations and tasking need to be available to the directing staff in a real time event analysis environment. Combined with simulation expert support, the reasons for events can be understood and a truthful explanation for events can be presented to exercise participants at all levels. Indeed due to limited information that exercise participants in headquarters, response cells and exercise control cells may have about the complete set of data that has led to a situation, it is likely that their interpretation of trends and events may be incorrect. Therefore, t is essential for exercise management staff to be able to uncover the rationale for particular situations in a very short time frame.

7.5 Analysis support

In order to provide exercise control and after-action-review support, capabilities should be provided that enable the capture of selected status data and event data capture. The requirements described in the previous sub-section should enable the definition of those indicators that are considered important from an exercise analysis perspective. The ability to relate the indicators to exercise objectives and derived sub-objectives is also necessary in order to verify the completeness of the analysis effort.

However exercise analysis introduces an additional dimension. Indeed the environment used by the subjects of the training or exercise needs to be monitored also in order to gain a complete understanding of the problem solving cycle that exercising staff performs. Instrumentation of both the exercise driving and of the headquarters command and control environments is required to permit complete analysis of the command, control, execution and reporting cycle.

7.6 Real-world command and control system mediation

The previous sub-paragraphs will have shown an evident need for close integration between the exercise environment and the command and control (C2) systems used by exercising headquarters. Firstly, the command and control systems need to be incorporated into the exercise control cells at response cell and exercise management level. Secondly the systems need to be open for instrumentation and data collection by exercise analysis tools for assessment purposes.

In order to ensure consistency between the representation of the world in the simulation environment and in the C2 systems and to provide the equivalent level of information exchange that exists between real-world levels of interaction within C2 systems, it is necessary to support the following aspects of mediation:

(1) Initialisation: it is necessary to be able to transform relevant simulation data base data into the appropriate format that can be used by the C2 applications. This includes entity status, perception and relevant system characteristics data. If the exercise is set on artificial geography, the mapping characteristics should also be exportable from the exercising to the C2 environments.

(2) Reporting: in order to provide exercising staff with doctrinally correct responses from subordinate or equivalent headquarters that are not exercising, it is necessary to provide response cells with the ability to extract relevant data from the simulation environment to provide status or event updates. Typically this form of mediation will require subject data to be formatted into specific messages that comply with prescribed encoding standards or to be achieved by being able to update C2 databases. In addition it may be necessary to support the generation of sensor output data from the exercising environment. Standard sensor communication protocols will need to be supported to populate perceived situation displays effectively.

(3) Ordering: in some cases, C2 systems are employed by headquarters that allow plans and tasks for subordinates to be expressed in a sufficiently formal manner that they can be interpreted by automated tools. In order to conduct exercises in the most efficient manner, mediation software should be available to transform the plans and tasks into actions that can be executed by simulated entities without manual intervention.

Given that the aspects of mediation described above are feasible, it is necessary to ensure that the necessary measures are taken to respect security regulations that exist when operating in close integration with C2 systems.

A Definition

Computer Assisted Exercise

An exercise using computer models designed to place the command and control element of a headquarters in a realistic, stressful combat-like environment to stimulate decision-making, command and control staff interaction and coordination

Though this is a somewhat generic definition, it highlights the key elements that comprise a computer assisted exercise.

First is the creation of a simulated environment that can stimulate human decision-making. Computer are used to simulate forces and their interactions and also for presenting relevant information to the participants. Typically, this is the command and control information that flows to and from commanders and their staffs.

Second, the computer assistance appears in several ways. The computerized combat simulations are used in the exercise preparation phase to construct and fine-tune the basic scenario. During the exercise, computers are used to simulate those elements in the exercise that are not played by people or real equipment. The exercise controllers to monitor the events and initiate corrective actions. Once the exercise ends, computers aid the analyses.

Third, computers are used to create linkage, or a translation, between the information and databases that make up the simulated environment, and the information and databases used by real command and control systems.

Applications of CAX include both education and training. For training, the typical audience may be smaller staff groups with a focus on specific areas or functions. For exercises, there is typically a broader scope of participants and the focus in on the functionality of a major organizational structure. A key interest in the latter case is to activate the command and control structure for crisis or wartime scenarios.

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Military Operations Requirements for Computer Assisted Exercises In NATO

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NATO Consultation, Command and Control Agency

Exercising: what is it and why is necessary ?

Some Definitions

- **Instruction: acquisition of skills by individuals or groups**
- **Training: improvement of performance by groups or individuals in applying acquired skills**
- **Exercising:**
  - **Maintain level of performance of acquired skills**
  - **Generalise level of performance through exposure to wide variety of situations**
  - **Develop knowledge about how to best apply acquired skills (meta-knowledge)**

Why exercise ?

- Considerable restructuring and reduction of forces
- Regular rotation of personnel in headquarters
- More diverse set of operations
- Composition of forces supporting operations often “ad hoc”
- Highly flexible set of constraints on mission execution
- Relatively short delays between mission identification and execution

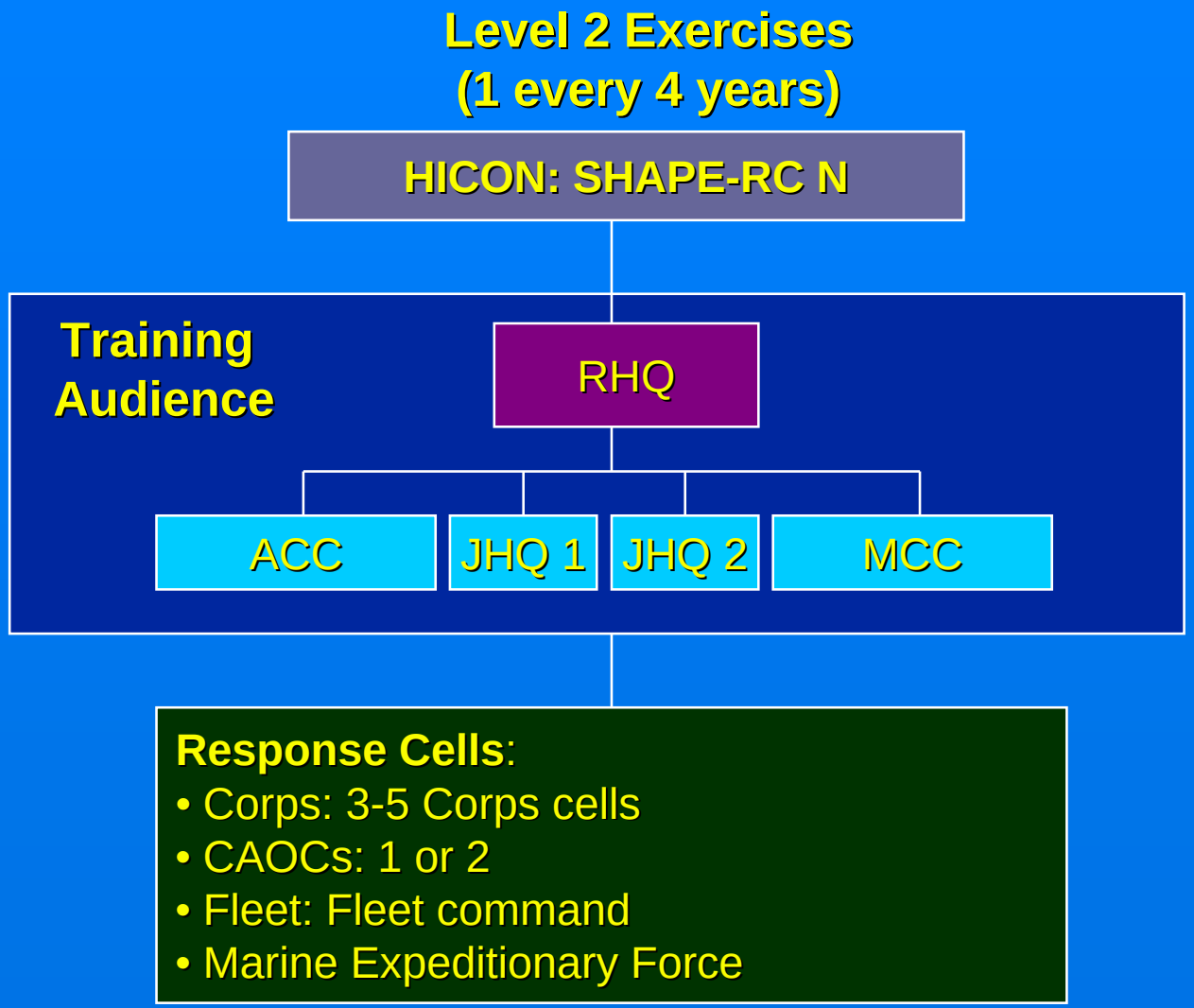
Classes of Computer Assisted Exercises

Definition of CAX

A Command Post Exercise in which computer-based simulation models are used to place commanders, staffs and their command and control systems in an operationally realistic environment in order to perform decision-making, practice staff procedures and co-ordinate between headquarters.

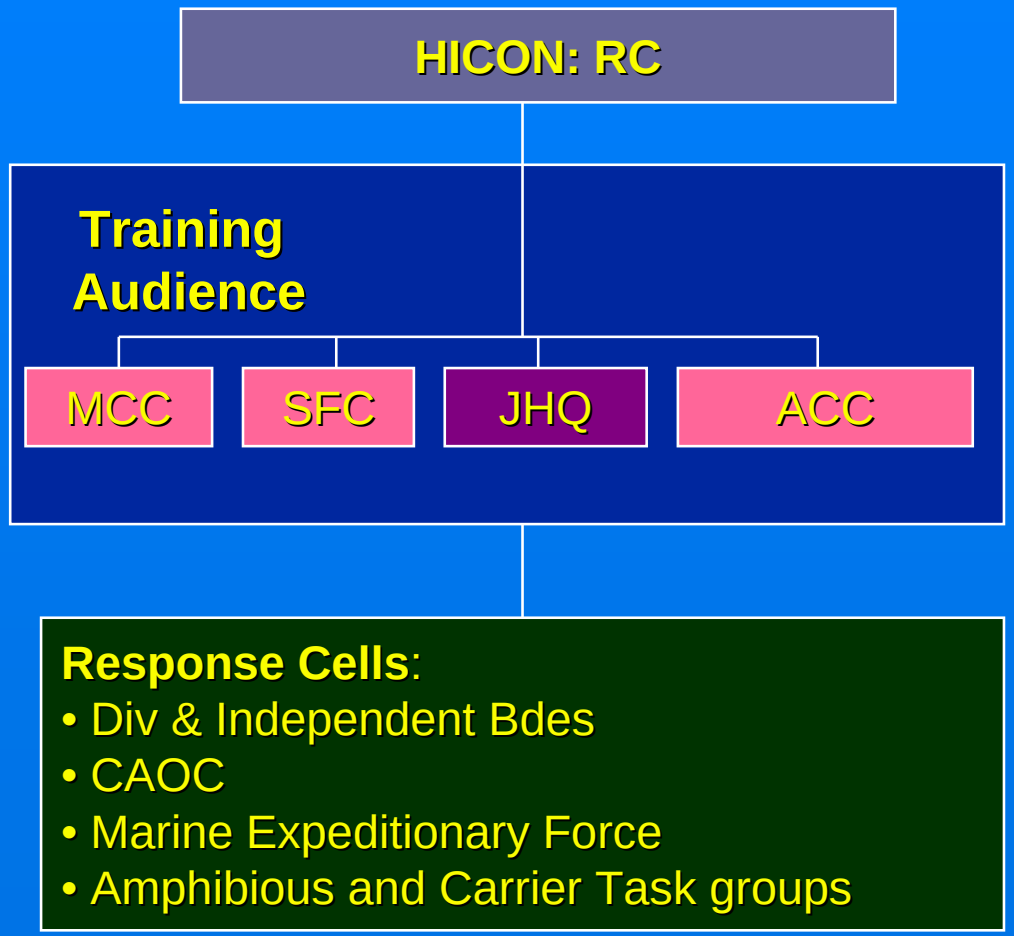
Source*: *ACE CAX Planners Course

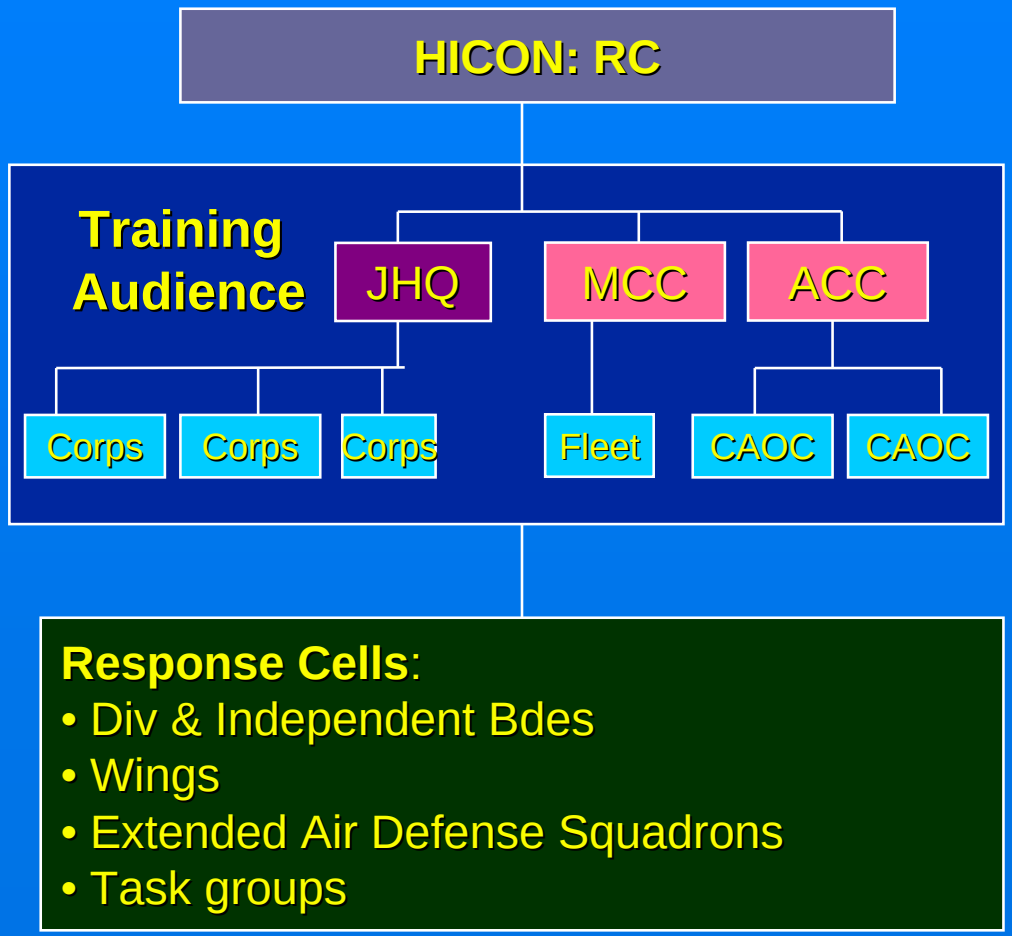
Level 2 Exercises



Level 3 Exercises

Level 3 Exercises
(every year except when level 2)





Implementation Requirements for Computer Assisted Exercises

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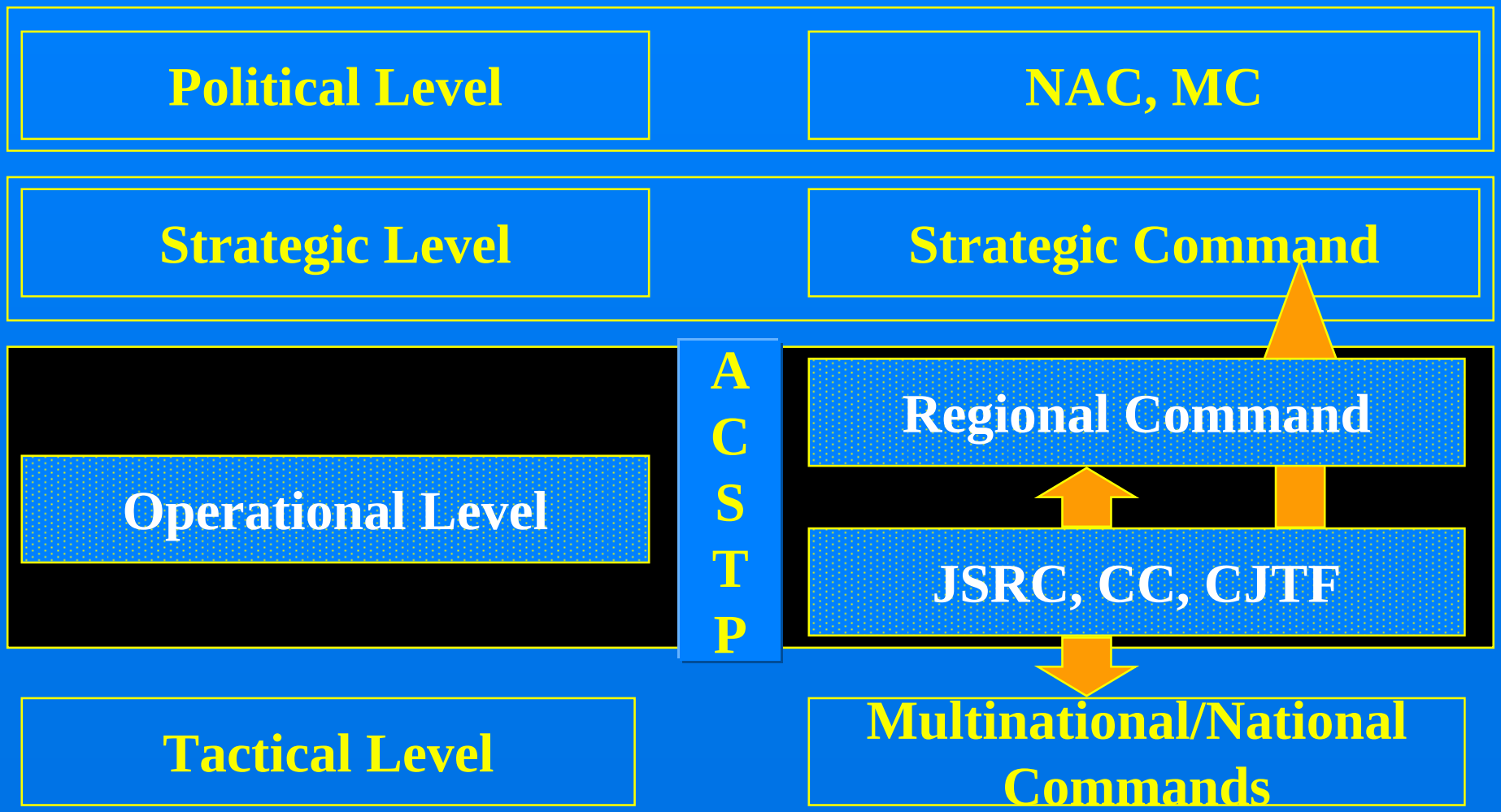
ACSTP Mission

- **Through *individual and collective training*, develop and sustain the ability of our regional, sub-regional, component, and CJTF Commanders and Staffs to conduct *joint, multi-national operations*, under Article 5 and non-Article 5 situations, both in and out of area, under Crisis Response conditions.**
- **Improve and preserve their knowledge of the operational level of war, operational art and its principles, and the design of joint campaigns IAW NATO's Operational Planning Process (OPP)**
- **Enhance interoperability within the Alliance at the operational and strategic levels**

Notes for Slide 10

Here's the mission of ACSTP (pause for reading)…the genesis of this programme sprang from GEN Shalikashveli's deep concern over the warfighting readiness and interoperability of our regional and component commanders and staffs--particularly given the enormous changes in NATO's security environment and the inevitable effects of long-term peace keeping operations in the Balkans--particularly the erosion of operational art, campaign planning, the force generation process, and sustained mastery of the operational-level, joint, multi-national warfare. GEN Joulwan and GEN Clark through their support behind the creation of ACSTP on their watch and we're now close to the objective.

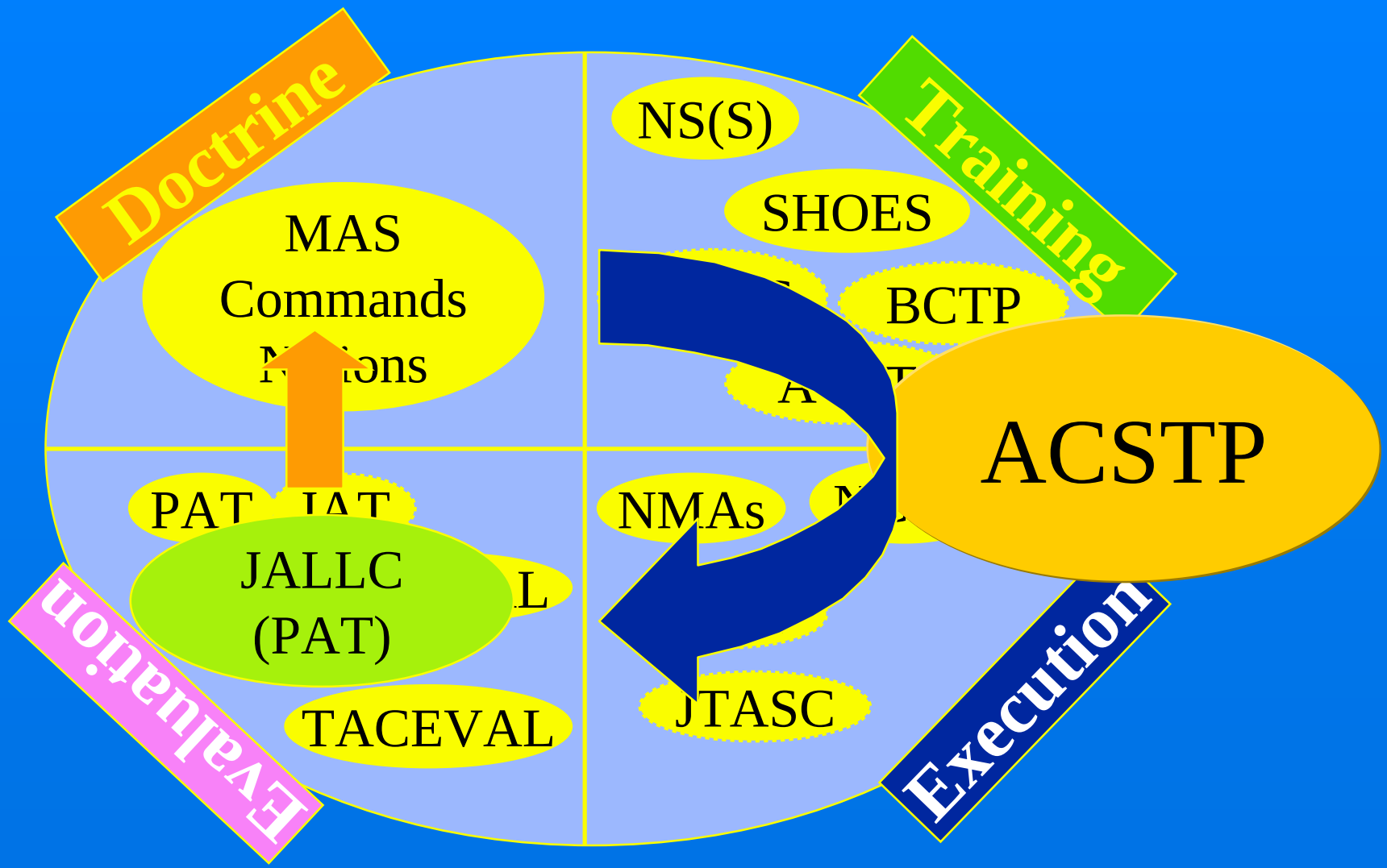
Training Focus



Notes for Slide 11

Here's where the ACSTP will perform its mission. The individual and collective training the team conducts will focus at the operational level of war--the target audience will be the commanders and staffs of our Regional, Joint Sub-regional, and Component commands, as well as any Combined Joint Task Force you may form. Training will focus at developing the knowledge, skill, and ability to plan joint campaigns and major operations, generate forces, synchronise and effectively employ all capabilities of the joint team, and sustain them until end states have been achieved--under Crisis Response situations, under Article 5 and non-Article 5 conditions, both in and out of area.

The Missing Link



Notes for Slide 12

- **The creation of ACSTP also fills in a missing link within our ACE training environment. Currently, you have no means of effectively training, developing, and assuring, through evaluation, that your commanders and staffs in your operational level headquarters actually possess the requisite knowledge, skills, and abilities required to perform their joint mission essential tasks under warfighting conditions. Granted our headquarters are conducting training exercises, but their actual performance and competencies remain a mystery--ACSTP gives you the capability to dramatically enhance and sustain their warfighting potential.**
-

Filling the Training Vacuum

Individual Training for Staff and Flag Officers

CAPEX

COOP-AUTO

MIDEX

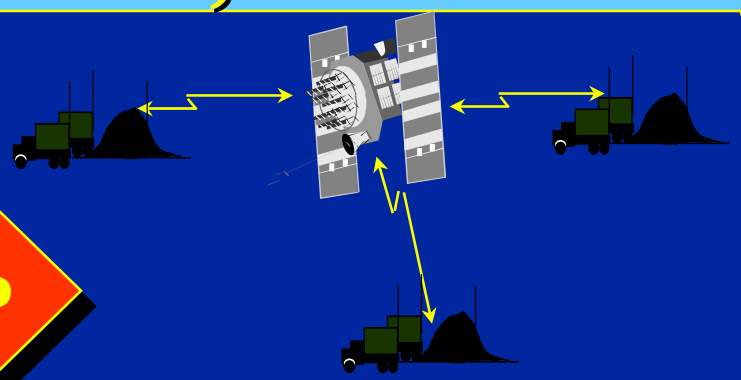
BRIGEX

HILEX

Academics and Practical Exercises

ACSTP

Collective Training of Regional, JSRC, CC, and CJTFs



Distributed Computer-Assisted Joint Exercises

Notes for Slide 13

During the past 4 years, Special Exercise Section, with GEN (Ret) Helge Hansen as our senior mentor, and augmentees from our regional commands, has been conducting the individual training the ACSTP will continue to provide. Three times a year we train Operational Planners throughout ACE in our MIDEX course. Once each year, we train one-star officers in BRIGEX, and two-four star officers in our HILEX course. Twice each year, we train Exercise Planners from ACE in our CAPEX course, and do the same for PfP nations in our COOPERATIVE AUTOMATION course.

For the past three years, our section has conducted battle staff training for commanders and staffs at JCSE, JCNE, and JCSW, and served as observers and evaluators for land component CAX exercises at JCSW and the ARRC.

ACSTP is the means of expanding this effort from individual to collective training and evaluation of our operational-level HQs throughout ACE.

ACSTP Deliverables

- Up to three collective training exercises per year
  - Pre-Initial Planning and Initial Planning Conferences
  - Staff Academics and PEs (individual operational staff training
  - Main Planning Conference
  - Planning Exercises (Joint Operational Planning Groups)
  - Final Planning and Final Co-ordination Conferences
  - Computer-assisted training exercises for the Headquarters
  - Observation, Assessment, Evaluations, and After Action Reviews

Notes for Slide 14

- **Here are the annual deliverables ACSTP will provide once it has reached FOC.**

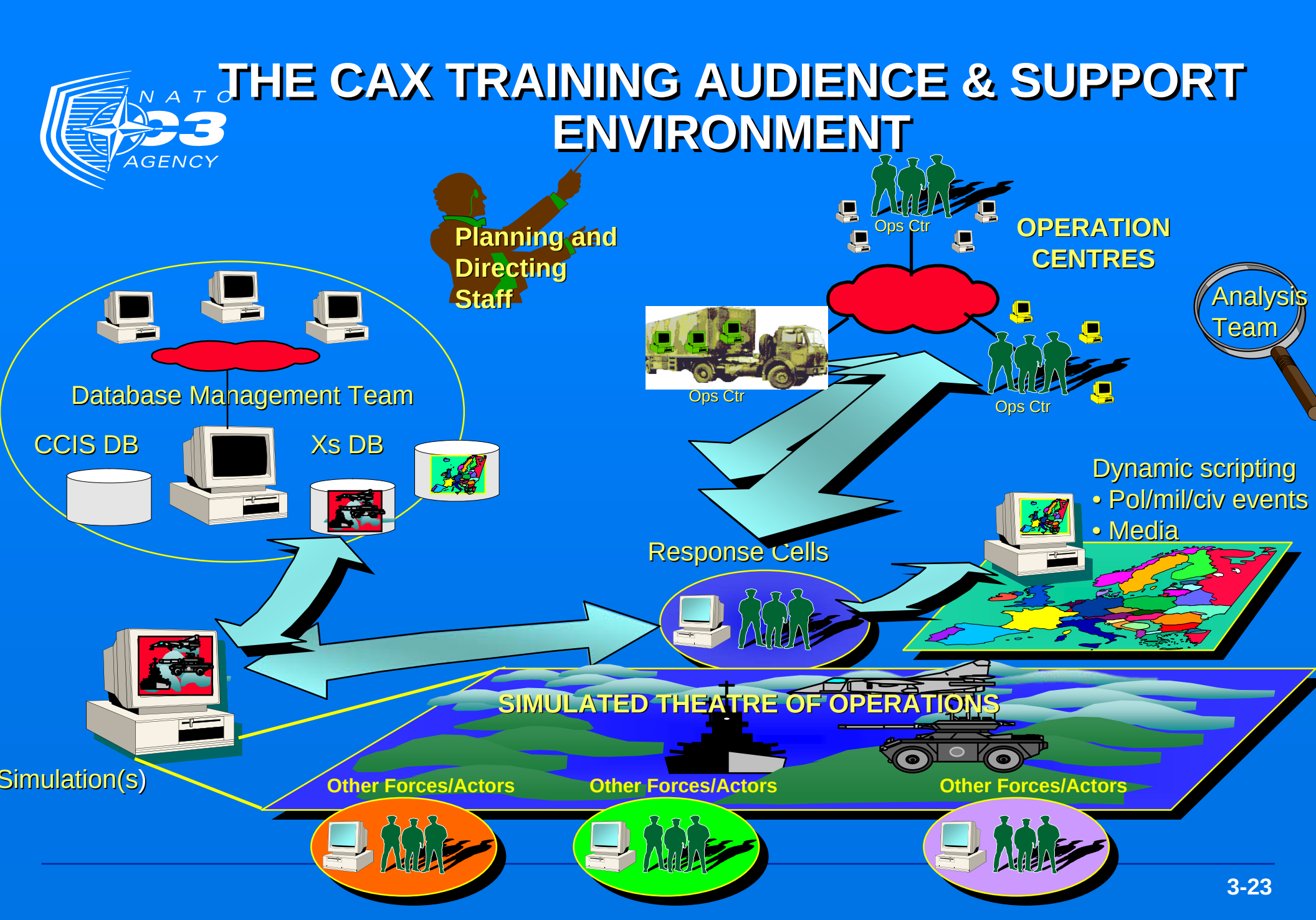
ACSTP Deliverables

- HILEX, MIDEX (3x), CAPEX (2x), COOP AUTO (1x)
- CAX planning assistance to NATO joint, operational headquarters, as well as PfP exercises
- NATO joint simulation improvements
- Support to the NATO Modelling and Simulation Working Group (MSWG)
- Insights, Observations, Lessons Learned (JALLC), doctrinal enhancement, and improvements to the OPP

Notes for Slide 15

- **Here are the annual deliverables ACSTP will provide once it has reached FOC.**

THE CAX TRAINING AUDIENCE & SUPPORT ENVIRONMENT



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Operational Requirements

Operation Types

- Peace Support Operations
  - Humanitarian aid
  - Disaster Relief
  - Search and Rescue
  - Peace Keeping
  - Peace Enforcement
- Collective defense or article V operations
- Executed by Joint force command and component commands Land, Air, Maritime, Marine, Logistics and Special Forces

Environmental Requirements

- Terrain
- Light conditions
- Weather
- Man-made environmental elements: smoke, obstacles
- Disease
- infrastructure

Force Representation Requirements

- Airbases
- Squadrons
- Personnel teams in exceptional conditions e.g. downed pilot
- Ground-based air defence and sensors
- Air missions
- Surface and sub-surface maritime craft
- Marine units
- Supply, maintenance, medical
- Special forces teams

Non-military Entities

- Civilian transportation assets
- Movement control authorities
- Food and water production and distribution assets
- Power and fuel production and distribution
- Medical support and transportation assets
- Non-Governmental and International Organisations
- Local population
- Media
- Specific persons e.g. leadership

Exercise Operational Requirements

- Set of simulations that are supported by knowledgeable experts needs to be available to select most suited
- Proven and validated data and methods for data production to populate trusted simulations
- Simulation exploration and data management organisation
- Exercise preparation requirements in terms of time and effort: total time should be within 3 to 9 months
- Execution requirements
  - time contraction variable to support execution and preparation between 0.01 and 60 times faster than real time
  - Size of response cells between 5 and 25 people
  - Limited training for new operators 2-3 days

Exercise Management Requirement

- Tools to express intended flow of exercise as related to exercise objectives
- To collect data during exercise execution and perform comparison with intended flow
- Aggregate measures definition and monitoring
- Critical event alerts
- Event explanation and traceback

Integration with real world C2 systems

- Support the initialisation of C2 systems with exercise setting
- Support generation of information flow from components external to primary participants
- Support interpretation of primary participant guidance and transformation into simulation-executable orders.